Undergraduate Syllabi –NEP 2020 Based

Introduced in all J&K Colleges

B.Sc. General
Bioresources

Type-I Courses

SEMESTER-I		SEMESTER-II	
(BRS122M)	**Bioresources-I** (Fundamentals of Bioresources)	**(BRS222M)**	**Bioresources-II** (Plant Resources)
(BRS022I)	**Bioresources-MD** Bioindustries		
SEMESTER-III		**SEMESTER-IV**	
(BRS322M)	**Bioresources-III** (Animal Resources)	**(BRS422M)**	**Bioresources-IV** (Microbial Resources)
SEMESTER-V		**SEMESTER-VI**	
(BRS522M)	**Bioresources-V** (Herbal Technology)	**(BRS622M)**	**Bioresources-VI** (Industrial Entomology)
SEMESTER-VII		**SEMESTER-VIII**	
(BRS722M)	**Bioresources-VII** (Bioresource Technology)	**(BRS822M)**	**Bioresources-VIII** (Biotechniques and Biostatistics)

Type-II Courses

SEMESTER-IV		SEMESTER-V	
(BRS422II)	**Bioresources-IV** (Bioresources in Immune Modulation)	**(BRS522II)**	**Bioresources-V** (Fungal Resources and Diseases Management)
SEMESTER-VI		**SEMESTER-VII**	
(BRS622II)	**Bioresources-VI** (Livestock Product Technology)	**(BRS722II)**	**Bioresources-VII** (Bioresource in Health Management)
SEMESTER-VIII			
(BRS822II)	**Bioresources-VIII** (Drug Discovery and Development)		

Type-III Courses

SEMESTER-IV		SEMESTER-V	
(BRS422III)	**Bioresources-IV** (Biomolecules)	**(BRS522III)**	**Bioresources-V** (Cell Biology)
SEMESTER-V		**SEMESTER-VI**	
(BRS622III)	**Bioresources-VI** (Molecular Biology)	**(BRS722III)**	**Bioresources-VII** (Human Genetics)
SEMESTER-VIII			
(BRS822III)	**Bioresources-VIII** (Research/Project)		

BACHELOR OF SCIENCE
BIORESOURCES SEMESTER 1st (Major/Minor: NEP-2020)

Course Code: (UGBRS22M101); Course Title: FUNDAMENTALS OF BIORESOURCES; Session 2022

CREDITS: THEORY: 4; PRACTICAL: 2
MAX MARKS: THEORY: 60; PRACTICAL: 30
CONTACT HOURS: THEORY (60); PRACTICALS:(45)

Learning objectives:
Students will be able to

1. Know about the diversity and values of important plant, animal and microbial resources.
2. Gain understanding about the methods of *in-situ* and *ex-situ* conservation strategies.
3. About the importance of biological resources in the management of livelihood and sustainable development.

Learning outcomes:
After the completion of the syllabus the student will acquire knowledge of.

1. Importance of biodiversity and its relationship with bio-resources.
2. Conservation of biodiversity and bio-resources for present and future generations.
3. Role of bio-resources and biodiversity in managing and sustaining livelihood.

Unit 1:-Bioresources (15 Lectures)

1.1 Bioresources— Plant, animal and microbial diversity (brief concept);
1.2 Concept and levels of Biodiversity
1.3 Mega-biodiversity countries
1.4 Biodiversity hotspots (concept and distribution)
1.5 Biodiversity and climate change— concerns and challenges
1.6 Valuing biodiversity— direct- and indirect use values.

Unit 2:- Biodiversity conservation (16 Lectures)

2.1 Species extinction, ultimate and proximate causes of Biodiversity loss
2.2 IUCN threat categories
2.3 Red data Book; Biodiversity surrogates
2.4 *In situ* conservation strategies— National parks, Wildlife sanctuaries and Biosphere reserves
2.5 *Ex situ* conservation strategies— Botanical gardens, Zoos, Aquaria, Cryo-banks.

Unit 3:-Bioresources and Livelihood (14 Lectures)

2.1 Livelihood and its relation with bioresources management;
2.2 Threats to traditional livelihood, food insecurity
2.3 Impact of globalization and urbanization on livelihood
2.4 Sustainable development
2.5 Energy crisis and need for green energy
2.6 Concept of green Building, vertical gardens
2.7 Eco-labelling (concept and examples)

Unit 4:-Bioresources Management policies (15 Lectures)

4.1 Indian Bioresources Information Network— organization and role
4.2 Convention on Biological Diversity (CBD)- Aims and objectives
4.3 Ramsar Convention; Biological Diversity Act (2002)
4.4 Environment Impact Assessment (EIA)- Concept and stages of EIA
4.5 Biodiversity conservation and public participation

Practical Work: 2 Credits

- Collection, description and herbarium preparation of various types of leaves, inflorescences and fruits.
- Determination of minimum size and number of quadrats for phytosociological studies.
- Computation of frequency, density and abundance of constituent species of different communities.
- Field demonstration of Global Positioning System (GPS) and its utility in biodiversity studies.
- Constituents of aquarium and construction of aquarium.
- Role of Herbarium and its significance in biodiversity studies.
- Prepare well labelled herbarium sheets of economically important plants.
- Prepare an inventory of important threatened wild animal species of Kashmir Himalayas with special reference to the causes of their population decline.
- Field study of various threatened endemic plants of Kashmir Himalaya.
- Prepare a list of in-situ conservation sites of Kashmir Himalayas.

Suggested Readings:

- An Advanced Textbook On Biodiversity: Principles And Practice, 2004, Krishnamurthy, Oxford and IBH Publishing ISBN, 8120416066, 9788120416062
- Principles of conservation biology, Gary K. Meffe
- Conservation Biology for All,2010, Navjot S. Sodhi and Paul R. Ehrlich, ISBN: 9780199554249
- Essentials of Conservation Biology 6th Edition, Richard B. Primack, SBN-13: 978-1605352893, ISBN-10: 1605352896
- Biodiversity: An Introduction, Kevin J. Gaston, John I. Spicer,
- Biodiversity, E.O. Wilson, National Academies Press, ISBN, 030956736X, 9780309567367

BACHELOR OF SCIENCE
BIORESOURCES SEMESTER 2nd (Major/Minor: NEP-2020)
Course Code: (UGBRS22M201); Course Title: PLANT RESOURCES; Session 2022

CREDITS: THEORY: 4; PRACTICAL: 2
MAX MARKS: THEORY: 60; PRACTICAL: 30
CONTACT HOURS: THEORY (60); PRACTICALS:(45)

Learning objectives:

Students will be able to

1. Understand about the classification and origin of plants in addition to the concept of bioprospection and biopiracy.
2. Acquire knowledge about underutilized food and fodder, their cultivation practices and utilization.
3. About the morphology and medicinal importance of wild vegetables and medicinal plants.

Learning outcomes:

After the completion of the syllabus the student will acquire knowledge of.

1. Origin and domestication of important crop plants and how bioprospection plays its role.
2. Morphology, cultivation and utilization of important food and fodder crops.
3. Important medicinal and aromatic plants of Kashmir region and their medicinal and aromatic use.

Unit 1: Plant resources (15 Lectures)

1.1 Introduction to Cryptogams and Phanerogams
1.2 Origin of agriculture
1.3 Centres of origin and domestication of cultivated plants (proposed by Vavilov)
1.4 Green revolution.
1.5 Bioprospecting— Concept
1.6 Role of traditional knowledge in bioprospecting
1.7 Biopiracy, case studies of biopiracy (Basmati, Neem, Turmeric)
1.8 Traditional Knowledge Digital Library (TKDL).

Unit 2: Food and fodder crops (16 Lectures)

2.1 Underutilised crops– importance as future food
2.2 Morphology, cultivation practice and limitations of buckwheat (*Fagopyrum* spp.) and foxtail millet (*Setaria italica*)
2.3 Morphology, cultivation and utility of rice (*Oryza sativa*) and maize (*Zea mays*)
2.4 Cultivation, extraction and processing of mustard oil
2.5 Fodder crops, cultivation and utility of alfalfa (*Medicago sativa*)
2.6 Pulses— *Cicer arietum* (Morphology and nutritional importance)

Unit 3: Fruits, vegetables and spices (15 Lectures)

3.1 Cultivation, storage and packaging of fruits (apple, walnut, Cherry and apricot)
3.2 Morphology and importance of wild vegetables (*Taraxacum officinale, Cichorium intybus, Rumax, Malva sylvestris*)
3.3 Spices and condiments, Saffron (Cumin, coriander, Fennel)
3.4 Non woody forest products (NWFP's): Important sources of gums, resins and dyes their economic importance.

Unit 4: Medicinal plants of Kashmir Himalaya (14 Lectures)

4.1 Morphology, ethnobotanical and medicinal importance of
- 4.1a *Artemesia absenthum*
- 4.1b *Arnebia benthamii*
- 4.1c *Atropa acuminate*
- 4.1d *Saussurea costus*
- 4.1e *Rheum emodi.*

4.2 Essential oils: Cultivation practice and extraction of lavender and rose oil, their economic importance.

Practical Work: 2 Credits

- Study the diagnostic features of some economically important angiosperm families (Asteraceae, Apiaceae, Brassicaceae, Fabaceae, Rosaceae, Lamiaceae and Poaceae).
- Study various types of plant fibres.
- Study the presence and structure of starch granules and oil bodies in various food crops.
- Estimation of starch content and its comparison in various food crops.
- Identification and cultivation practices of oil yielding crops- Sunflower and Mustard.
- Pseudocereals- Buckwheat: Morphological features and seed structure; Test for presence of starch and proteins.
- Collection of wild vegetables from the field and preparation of herbarium.
- Identification of some commonly used spices and condiments.
- Study the diagnostic features and medicinal importance of native medicinal plants of Kashmir Himalaya.

Suggested Readings:

- Textbook of Economic Botany, 2009, Verma V, Ane Books Pvt Ltd, ISBN 8180521672, 9788180521676.
- Textbook of Economic Botany, 2016, ISBN-13: 978-8193241554
- Economic Botany, B P Pandey, S. Chand Publishing, ISBN 9788121903417
- Economic Botany Paperback, 2009 , S. Sen, New Central Book Agency (1 January 2009) ISBN-10: 8173812063, ISBN-13: 978-8173812064
- Economic Botany, Principles and Practices, **Wickens,** G.E. © 2017 Springer International Publishing ISBN 978-0-7923-6781-9

BACHELOR OF SCIENCE

MULTI-DISCIPLINARY INTRODUCTORY COURSE (BIORESOURCES)
SEMESTER-I (NEP-2020)

Course Code: (UGBRS22D102); Course Title: BIOINDUSTRIES; Session 2022

CREDITS: THEORY: 3
MAX MARKS: THEORY: 45
CONTACT HOURS: THEORY (45)

Learning objectives:

This course is designed to acquaint the student with:

1. Concept, scope and status of bioindustries at local and regional level.
2. Different types of waste utilization and bio-energy sources
3. Green economy, entrepreneurship and intellectual property rights

Learning outcomes:

After successful completion of the course the students will be able to elucidate:

1. Establishment of bioindustries and their role in economic growth.
2. Waste utilization and energy production from natural sources.
3. Marketing strategies and value addition.

Unit 1: Introduction to Bioindustry (15 Lecture)

1.1 Bioindustry- Concept and recent trends in the development of Bioindustry
1.2 Scope and status of Bioindustries in India (Dairy, Sheep, Floricuture)
1.3 Scope and status of Bioindustries in J &K (Dairy, Sheep, Aquaculture, Horticulture, Cosmetics, Fertilizers, Leather, aquaculture, Ornamental horticulture and Herbal Medicine)
1.4 Agriculture crop production trends and demand for staple food.

Unit 2: Bio-based waste utilization (15 Lecture)

2.1 Composting, vermicompositing- methods, materials and advantages
2.2 Pulping (mechanical and chemical pulping)
2.3 Municipal wastes- segregation and uses
2.4 Bio-based plastics and fibres
2.5 Biomass as energy source, Biogas production, Bio-fuels- Concept and classification
2.6 Concept of Bio-villages and biotechnological parks.

Unit 3: Green economy and Entrepreneurship (15 Lecture)

3.1 Marketing strategies for Bioresources products- Product launching, evaluation and advertisements, value addition
3.2 Entrepreneurship, Small Scale Industries, Self employment schemes in relation to bioindisutries;
3.3 Status and scope and of establishing bio-based small scale industries
3.4 Concept of Green entrepreneurship.
3.5 Intellectual property rights (Patents, Copy Rights, & Trademarks)

Suggested Readings:

- Entrepreneurship: New Venture Creation, David H. Holt
- Entrepreneurship and Small Business Management: C.B. Gupta, S.S. Khanka,
- Vermiculture and Organic Farming. Sathe, T.V. (2004) Daya publishers.
- Bio-fertilizers and organic Farming Vayas S.C, Vayas, and Modi, H.A. (1998)
- Principles of Intellectual Property. N.S. Gopala Krishnan & T.G. Agitha, (2009)
- Entrepreneurial Development by S.S. Khanka (S.Chand)
- Intellectual property rights in the WTO and developing countries. Watal J (2001)

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BACHELOR OF SCIENCE
3rd SEMESTER
DISCIPLINE SPECIFIC COURSE – 3 (CORE - 3)
BRS321C: BIORESOURCES: ANIMAL RESOURCES

Credits: Theory: 4; Practical: 2
Max Marks: Theory: 60; Practical: 30
Min Marks: Theory: 24; Practical: 12
Theory (Lectures: 60)

Unit: I **(14 Lecture)**

Introduction to Animal Resources: Important animal resources; Aquaculture, cattle, goats, poultry, and sheep in human service; Principles and practices for production of high quality milk, meat and eggs; Scope of meat, fish and poultry processing industry in J&K.

Unit: II **(14 Lecture)**

Livestock: History of domestication; Important methods of selection and systems of breeding in farm animals and poultry birds; applications of inbreeding and out-breeding; Genetic basis of heterosis and its use.

Unit: III **(16 Lectures)**

Aquaculture: Status and prospects; Role of aquaculture in food supply; Agencies involved in promoting academic, research and entrepreneurship in aquaculture; Types of farming systems- extensive, semi intensive and intensive culture; Cage culture;Integrated fish farming with details of paddy-cum-fish culture.

Unit: IV **(16 Lectures)**

Insect resources: Importance and scope of insect based industries; Honey industry, Silk Industry andLac industry; Advances in insect based industries of J&K and their economic potential; Insects as biosensors; Use of insects in Forensic Science and Biomedicine; Role of insects in pollination.

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Practical Work: 2 Credits

- Study the procedure to ascertain the quality of silk,wool, honey, milk and meat.
- Study of life history of silk worm by rearing.
- Dissection of silk glands of the silk worm larva.
- Identification of culturable fishes in Kashmir valley.
- Demonstration of induced-breeding technology in cultured fishes.
- Identification of various breeds of cattle, buffalo, sheep and goat.
- Study the methods of preparation of different kinds of feed for Fish, Poultry and livestock
- Field trips to an organised poultry farms, fish hatchery, Sericulture research stations and Dairy farms.

Suggested Readings:

- Prost, P.J. (1962) Apiculture. Oxford and IBH, New Delhi.
- Srivastava, C.B.L. (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.
- Dunham R.A. (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publications, U.K.
- Atwal, A. S. (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, New Delhi.
- Atwal, A. S. (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, New Delhi.
- Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea &Fabiger Publisher.

BACHELOR OF SCIENCE
BIORESOURCES SEMESTER 4th

Course Code: (BRS422III); Course Title: Biomolecules;

CREDITS: THEORY: 4; PRACTICAL: 2
MAX MARKS: THEORY: 60; PRACTICAL: 30; INTERNAL MARKS: 10
MIN MARKS: THEORY: 24; PRACTICAL: 12

Unit: I **Lectures 17**

Carbohydrates and Lipids: Introduction and Classification of carbohydrates; Isomerism (D & L and R & S system); Optical properties of carbohydrates; Reducing and Non-reducing sugars; Storage and structural polymers and their importance (starch, glycogen cellulose, hemicelluloses); Introduction and classification of lipids; Biological functions of triacylgycerols, phospholipids, glycolipids, sphingolipids and cholesterol.

Unit: II **Lectures 17**

Proteins and Enzymes: Structure and classification of amino acids; Stereoisomerism in amino acids, Protein structure (primary and secondary structure of proteins); Fibrous and globular proteins (α-keratin, collagen, haemoglobin); Nomenclature and types of enzymes; Mechanism of enzyme action (Michaelis-Menton Equation); Enzyme inhibition (reversible and irreversible inhibition).

Unit: III **Lectures 14**

Nucleic acids: Structures of Nucleotides**;** DNA double helix (Watson and Crick Model); Forms of DNA (A, B, Z and H DNA); Types of RNA; Structure of tRNA and mRNA; Packaging of genetic material (Nucleosome model); Chromosome structure; Euchromatin and heterochromatin; Polytene and Lampbrush chromosomes.

Unit: IV **Lectures 16**

Secondary metabolites: Types of secondary metabolites; Phenolic compounds—occurrence and classification; Terpenes— Occurrence and classification based on isoprene rule; Steroids— structure and occurrence; Alkaloids—Occurrence and classification based on nitrogen heterocyclic ring; Importance of secondary metabolites in food and medicine.

Practical work:

- Preparation of calibration graph for the estimation of starch and proteins.
- Determination of saponification value of fat/oil.
- Extraction of proteins from fresh material.
- Determination of the time course of diastase action on starch.
- Determination of polyphenol oxidase activity.
- Extraction and estimation of total titrable acidity in plant extract.
- Separation of pigments from leaf extract using phase separation method.
- Detection of presence of phenolics, alkaloids and flavonoids in plant material.
- Preparation of calibration graph for the estimation of total phenols.
- Study the effect of pH on the anthocyanins from fruit extracts.

Suggested Readings:

1. D. L. Nelson and M.M. Cox. Lehninger Principles of Biochemistry. W.H. Freeman. 8th Edition. 2021.
2. Donald Voet, Judith G. Voet, Charlotte W. Pratt. Fundamentals of Biochemistry: Life at the Molecular Level. 5th Edition. 2016.
3. Lubert Stryer, Jeremy Berg, John Tymoczko, Gregory Gatto. Biochemistry. 8th Edition. 2015.
4. U. Satyanarayana, U. Chakrapani. Biochemistry. Elsevier, 2021.
5. S. P. Singh. Textbook of Biochemistry. CBS Publication. 2015.
6. J. L. Jain, Sunjay Jain and Nitin Jain. Fundamentals of Biochemistry, S. Chand. 7th Edition. 2014.
7. Gerald Karp, Janet Iwasa, Wallace Marshall Karp. Cell and Molecular Biology. 9th Edition. 2019.
8. Krebs, Jocelyn E., Goldstein, Elliott S., Kilpatrick, Stephen T. Lewin's genes XI. Jones & Bartlett Learning, LLC. 2018.
9. Gupta. P.K. Cell and Molecular biology. Rastogi Publications, India. 2005.
10. Rastogi, S.C. Cell and Molecular Biology. New age International Publishers, India. 2012.

Type-II: Bioresources in immune Modulation-IV (BRS422M) Semester 4th Credits 4 (theory 3 +practical 1)

Bioresources in Immune Modulation

Theory
Lectures: 60

Unit: I **(16 Lecture)**

Basics of Immunology: Introduction to immune system: Cells and organs of immune system; Antigens, haptens, and monoclonal antibodies; B and T lymphocytes, phagocytosis, complement system, cytokines, chemokines, inflammatory mediators. Immunoglobulins: Types, Structure and function; Immunology in health and disease-Immunological disorders and concept of immunotherapy.

Unit: II **(16 Lecture)**

Immunomodulatory leads from medicinal plants: *Andrographis paniculata, Curcuma longa, Echinacea purpurea, Withania somnifera, Tinospora cordifolia, Ocimum sanctum, Azadirachta indica, Boswellia serrata, Momordica charantia, Panax ginseng* and *Boerhaavia diffusa*.

Major groups of plant-derived nutraceuticals; Polysaccharides, Fatty Acids, Labdane Diterpenes: Chemical Features, Natural Occurrence, Pharmacological Properties and Clinical studies.

Unit: III **(14 Lecture)**

Immunomodulation by food: Enhancement of immune responses by food; Probiotics and other microorganisms, Prebiotics and bacterial metabolites; Polysaccharides, Vitamins, Fatty acids, amino acids and other micronutrients.

Immune Inhibition by functional food: Hypoallergic food and use of oral tolerance; Prebiotics and bacterial metabolites; Polyphenols, Peptides, proteins and related substances.

Unit: IV **(14 Lecture)**

Immunomodulatory Compounds from Marine Organisms: Immunomodulatory Proteins and Amino Acid; Hemocyanins, Lectins, Taurine. Immunomodulatory Peptides; Callinectin, crustin, Myticin, Mytillin, Mytimycin.

Immunomodulatory Protein Hydrolysates: Chlorella Protein Hydrolysate, Ecklonia Protein Hydrolysate, Porphyra Protein Hydrolysate, Edible Red Algae Protein Hydrolysate, Edible Microalgae Spirulina Protein Hydrolysate, Oyster Peptide-Based Enteral Nutrition Formula, Shellfish Mytilus and shark Protein Hydrolysate

Type-I: Microbial Resources-IV (BRS422M) Semester 4th Credits 6 (theory 4 +practical 2)

Microbial Resources

Theory
Lectures: 60

Unit: I **(16 Lecture)**

Introduction to Microbial Resources: Historical perspective; General characteristics of microbial resources (bacteria, algae, and viruses). Ultrastructure of Bacteria: (Internal Structure, Cell wall and External Structure); Viruses: general structure and viral classification. Gene transfer in bacteria (Different modes of gene transfer).

Unit: II **(16 Lecture)**

Microbial Growth: Principle and procedure of sterilization (moist heat, filtration and chemical treatment); Microbial culture and its growth kinetics; Growth rate parameters - specific growth rate, doubling time. Measurement of microbial growth, factors affecting microbial growth.

Unit: III **(14 Lecture)**

Microbial resources and crop productivity: Production and application of *Rhizobium, Azospirillum, Azotobacter;* Plant growth promoting Rhizobacteria (PGPR's) and their uses; Biofilmed fertilizers.

Microbes of industrial importance: Probiotics in promoting human health; Microbial cells as food (single cell proteins).

Unit: IV **(14 Lecture)**

Bioactive microbial agents: Biopolymer and bio-surfactant production from microbial resources; Medicine from microbes.

Microorganisms and environment decontamination: Microorganisms in wastewater decontamination; Bioremediation through the use of microbial resources

Practical Work:

- Basic bacterial staining, capsule staining, flagella staining and algal staining.
- Preparation and sterilization of solid and liquid culture media for bacterial cultivation.
- To check the efficacy of antimicrobial agents
- Streak plate and spread plate, isolation of single colonies of bacteria.
- Preparation of slides of rhizobium isolated from leguminous plants.
- Alcohol production by fermentation of sugars.
- Isolation of lactobacillus from milk products and observation of bacilli under microscope.

Suggested Readings:

- Microbiology by Nina Parker, Mark Schneegurt, Anh-Hue Thi Tu, Brian M. Forster, Philip Lister, by ASM Press and OpenStax. 2017, ISBN-13, 978-0-9986257-0-6
- Essential Microbiology by Stuart Hogg, John Wiley & Sons Ltd 2005, ISBN 0471497533
- The handbook of microbial bioresources. Eds: Gupta, V. K., Sharma, G. D., Tuohy, M. G., Gaur, R. (2016) ISBN 9781780645216.
- Biotechnology of Biofertilizers Editors: Kannaiyan, Sadasivam (Ed.) (2002) Springer Netherlands ISBN: 978-1-4020-0219-9.
- Microbiology: Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. – McGraw-Hill.
- Industrial Microbiology, Casida - New Age International Private Limited
- Microbes as Bio-fertilizers and their Production Technology S. G. Borkar (2015) Woodhead Publishing India in Agriculture. ISBN 9789380308579.
- Bioremediation of Wastewater: Factors and Treatment. Ed: Olga Sanchez (2017) Apple Academic Press; 1st ed. (2015). ISBN-13: 978-177188162.
- General Microbiology: Stanier, R. Y., Ingraham, J. L., Wheelis, M. L. and Painter, P. R. – Macmillan Press Ltd., UK. 4.
- Microbiology: Prescott, L. M., Harley, J. P. and Klein, D. A. – McGraw-Hill.

Expected Learning Outcomes:

1. Understanding of microbial growth, kinetics and measurement.
2. Detailed understanding of bacteria/viruses and gene transfer methods in bacteria.
3. Brief idea of bioremediation and biodegradation of organic pollutants
4. Understanding of industrial and economic importance of microbes.

Syllabus: K.U. Bioresources for 5th Semester **Course Code: BRS522J1**

Course Title: Herbal Technology

Semester V (Type 1) Credits 4 (theory 3 +practical 1) Maximum Marks: 100 (75L+25P)

Learning Objectives

- To learn about various herbs, methods of crude herbal extraction and processing and types of formulations used in traditional system of medicine.
- To study about the ethno-botanical and medicinal importance of selected medicinal plants of Kashmir Himalaya.
- To learn about various botanical used for skin and hair care in traditional system and modern cosmetics.
- To study about the herbs used in oral health and hygiene and fragrances.

Learning Outcomes

- To have idea about different types of herbal extracts and preparations used in traditional systems of medicine.
- To understand the importance of plants as a rich sources of medicine and their use in traditional healthcare especially for those living in close proximity with nature like tribal and forest dwellers.
- To understand the concept of biocosmetics and herbs used in formulations for skin and hair care in general.
- To have know-how about common herbal sources fragrances and use of herbs in oral care.

Unit: I **(15 Lecture)**

Herbs-Processing and Extraction: Concepts of herbs; Collection, processing and storage of herbs; Types of extracts- Decoction, Infusion, Digestion, Tinctures, Liquid extracts, Soft extracts, Dry extracts; Methods of extraction- Maceration and Digestion Percolation, Soxhlet Extraction, Extraction of essential oils (Water and Steam Distillation).

Unit: II **(15 Lecture)**

Herbs in medicine: Historical perspective of herbs in traditional health management; Ethno-botanical and medicinal importance of *Atropa acuminate, Aconitum heterophyllum, Saussurea costus, Arnebia benthami, Catharanthus roseus, Digitalis purpurea;* Herbal nutraceuticals and their role in managing Diabetes, CVS diseases, Cancer, and various Gastro intestinal diseases.

Unit: III **(15 Lecture)**

Herbs in cosmetics: Herbal sources of fixed oils, waxes, gums, bleaching agents, antioxidants for skin and hair care; Herbs in Shampoos, surfactants and conditioners; Biobased hair colourants; Biobased products in hair fall control; Herbs in oral health and hygiene; Herbs as sources of fragrances (lavender, rose, rosemary).

Practical Work:

- Morphological identification of important medicinal plants of Kashmir Himalayas.
- Qualitative test for presence of secondary metabolites (Alkaloids, terpenes, tannins, glycosides, phenols)
- Quantitative estimation of sugars and Phenols.
- Methods of extraction (Demonstration of Maceration, Digestion and Soxhlet extraction)
- Morphology andimportance of Lavender and Rose.
- Ethno-medicinal Survey & documentations.

Suggested Readings

- Agarwal, S.S. and Paridhavi, M., "Herbal Drug Technology" Universities Press (India) Private Limited, 2007.
- Vipin Kumar Singh, VP, Das S, Kumar M.(2018) Bioprospection of Traditionally used Medicinal Plants: An Overview.
- Panda H (2004) Handbook of Herbal Drugs and its plant sources.
- Khare, C.P (2004) Indian Herbal remedies-Rational Western therapy, Ayurvedic and other usage, Botany, Springer.
- Daniel, M., "Herbal Technology: Concepts and Advances" Satish Serial Publishing House, 2008.
- Cosmetic Science and Technology Vol I, II, III by Sagarin.
- Cosmetics Analysis selective methods with techniques by P. Bare.
- Bannerman, R.H., Burton, J. and Wen Chen, C. (eds). 1983. Traditional medicine and health care coverage. WHO, Geneva.
- Pushpangadan, P. 1995. Ethnobiology in India: a Status Report. All India Coordinated Research Project on Ethnobiology. Ministry of Environment and Forests, Govt. of India, New Delhi.

Syllabus: K.U. Bioresources for 5th Semester **Course Code: BRS522J2**

Course Title: Fungal Resources & Diseases

Semester V (Type II) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

Course objective: To provide detail knowledge about the fungal pathogens their ecology and host-pathogen interactions, development of diseases and their epidemics and management through various approaches. To classify fungi and phylogeny, thallus structure, nutrition and reproduction and their economic importance for the welfare of mankind. To provide detail knowledge about the macro-fungi (mushrooms), edible fungi and important cultivated mushrooms, their cultivation technology, and production. Imparting knowledge about fungi-host interactions.

Course outcome: Students are expected to develop a tangible idea about the fungi and their different dimensions concerning ecology, disease and management which help to initiate research in fungal pathology. Students will gain knowledge about the mushrooms, their biology and cultivation techniques for conducting individual research on mushroom and entrepreneur development.

Unit: I **(14 Lecture)**

Introduction to fungi: General characteristics; Classification based on Nutrition (saprophyte, biotrophic, symbiotic, predaceous); Affinities with plants and animals; Thallus organization; Cell Structure; General characteristics of Chytridiomycota, Zygomycota, Ascomycota, Basidiomycota, (Overview); Economic importance of fungi (Decomposition of organic matter, lignin and pesticides).

Unit: II **(16 Lecture)**

Applied Mycology: Role of fungi in beverage (Beer, lager, sake) and bread making industry. Antibiotics from fungi— penicillin, cephalosporins, Clavicin, Griseofulvin, Ergot alkaloids; Edible mushrooms, Life cycle of *Agaricusbisporous.* Mushroom production and cultivation techniques. Non-edible and poisonous mushrooms (*Amanita phalloieds*)

Unit: III **(16 Lecture)**

Human pathogenic fungi: *Candida spp., Aspergillus spp, Cryptococcus spp*.; Opportunistic Fungal Pathogens of Humans; Human Fungal Diseases: *Candidiasis, Aspergillosis, Cryptococcosis. Mucormycosis, Histoplasmosis*; Fungal infections: Superficial Infections, Subcutaneous Infections, Systemic Infections: Antifungal drugs, their mode of action and drug resistance

Unit: IV **(14 Lecture)**

Fungi and plant health: Plant disease — Apple scab, Early blight of potato, Loose and covered smut, soft rot and damping off disease (Causative organisms, symptoms and control measures).

Fungi as biocontrol agents (mycofungicides, mycoherbicides, mycoinsecticides, myconematicides); Mycorrhizas (Endo- and ecto-mycorrhiza) role in plant health; Lichen: Classification& Economic Importance.

Practical Work:

➢ Alcohol production by fermentation of sugars.

➢ Identification of permanent slides of penicillium, yeasts,

➢Study of fungal diseases in the field: Blast of rice, Tikka disease of ground nut, powdery mildew of locally available plants and white rust of crucifers.

➢Agaricus: Specimens of button stage and full grown mushroom; sectioning of gills of Agaricus, and fairy rings are to be shown.

➢Mycorrhiza: ecto mycorrhiza and endo mycorrhiza (Photographs)

➢ Preparation of solid and liquid culture fungal growth media.

➢ Streak plate and spread plate, Isolation of single colonies of fungi on solid media.

Suggested Readings:

- ➢ Mushroom Production and Processing Technology. Eds: Pathak VN / Yadav N / Gaur M (2013) Published by Agrobios (India), Jodhpur ISBN 13: 9788177540062.
- ➢ Introduction to Fungi 3rd edition by Webster, John, Weber, Roland (2007) Cambridge University Press. ISBN-13:9780521014830.
- ➢ Medically Important Fungi: A Guide to Identification – 5th Edition by LaroneDavise H. (2011) ASM Press. ISBN: 978-1555816605.
- ➢Introduction to Fungi. 3rd Edition (2007) Webster & Webster. Cambridge University Press.
- ➢Larone's Medically Important Fungi: A Guide to Identification, 7th Edition Lars F. Westblade, Eileen M. Burd, Shawn R. Lockhart, Gary W. Procop ISBN: 978-1-683-67442-9 (2023) ASM Press
- ➢Cryptococcus neoformans (2014) Arturo Casadevall, John R. Perfect ISBN: 978-1-683-67264-7 ASM Press
- ➢An Introduction to Fungi. Dube H.C. 2012. Scientific Publishers
- ➢Molecular Principles of Fungal Pathogenesis (2014) Joseph Heitman (Editor), Scott G. Filler (Editor), John E. Edwards Jr. (Editor), Aaron P. Mitchell (Editor) ISBN: 978-1-683-67180-0, ASM Press
- ➢Introductory Mycology. Dorian Snyder. 2019.Larsen & Keller Educ.

➢Aspergillus fumigatus and Aspergillosis (2014) Jean-Paul Latge (Editor), William J. Steinbach (Editor) ISBN: 978-1-683-67138-1, ASM Press

➢Cellular and Molecular Biology of Filamentous Fungi (2014) Katherine A. Borkovich (Editor), Daniel J. Ebbole (Editor) ISBN: 978-1-683-67129-9, ASM Press

➢Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press,Cambridge.3rd edition.

➢Deacon, J.W. (2013). Fungal Biology, 4th edition, John Wiley &Sons Ltd

➢Candida and Candidiasis, 2nd Edition (2014) Richard A. Calderone (Editor), Cornelius J. Clancy (Editor) ISBN: 978-1-683-67095-7, ASM Press

➢The Fungal Kingdom (2017) Joseph Heitman, Barbara J. Howlett, Pedro W. Crous, Eva H. Stukenbrock, Timothy Yong James, Neil A. R. Gow ISBN: 978-1-683-67082-7 ASM Press

Course Title: Cell Biology

Semester V (Type 3) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

Learning Objectives:

- To study the structural organization of prokaryotic and eukaryotic cells and general structure and similar and differences in cell wall in prokaryotes and eukaryotes.
- To study the structural of cell membrane, cell organelles and their role in important processes.
- To learn about the various phases of cell cycle and structural organization of cytoskeleton, cell adhesion and cell junctions

Learning Outcomes:

- To understand complexity of structural organization of cell and organization of cell membranes, cell wall and extracellular matrix.
- To understand the organisation of eukaryotic cell and the structure and role of cellular organelles.
- To understand the process of cell cycle and cell division and importance of checkpoints in cell cycle.

To understand the basis and structural organization of cell— cell interaction and cell matrix organisation.

Unit: I **(15 Lecture)**

Cells and cell membrane: Types of cells (Bacteria, Archaea (prokaryotic) and eukaryotic cells)- similarities and differences; Cell membrane structure and composition, Fluid Mosaic Model of cell membrane; Components of extracellular matrix; Cell wall structure (comparison of bacterial, plant and fungal cell wall).

Unit: II **(15 Lecture)**

Cytoskeleton and Cell junctions: Cytoskeleton— microtubules, actin filaments, intermediate filaments; Centriole and basal bodies. Cell-Cell Interactions (tight junctions, desmosomes, hemi-desmosomes, gap junctions and plasmodesmata).

Unit: III **(15 Lecture)**

Intracellular organelles: Structural organization of endoplasmic reticulum,golgi bodies, ribosome, lysosomes, peroxisomes, vacuoles; Structural organization and genome organization in mitochondria and chloroplast; Structural organization of nucleus—nuclear membrane and nuclear pore complex, Nucleolus, Nuclear matrix;

Unit: IV **(15 Lecture)**

Chromosomes and Cell cycle: Chromosome structure; Types of Chromosomes (Lampbrush and Polytene chromosomes). Chromosomal aberrations (Deletion, Duplication, Inversion and Translocation) Characteristics features of phases of cell cycle; Cell Cycle Check points and their importance; Phases and importance of mitosis and meiosis;

Practical Work:

- Comparative study of prokaryotic & eukaryotic cells
- Comparative study of plant & animal cell.
- Study Membrane stability Index.
- Study of stages of Meiosis and Mitosis from permanent slides.
- Study pollen mother cell meiosis.
- Study meiotic stages during gamete formation in grasshopper
- Study stages of mitosis from root tips.
- Extraction of Nuclear DNA.

Suggested Redaings:

- Cell and Molecular Biology Biology, P.K. Gupta. ISBN: 8171338178.
- Cell and Molecular Biology: Concepts and Experiments, Gerald Karp, John wiley publishers New York. ISBN: 111830179X.
- Cell Biology.C.B.Powar. ISBN: 9350246694
- Geoffrey M. Cooper . The Cell: A Molecular Approach. ISBN: 1605351555.
- Bruce Alberts, Dennis Bray, Karen Hopkin and Alexander Johnson: Essential Cell Biology. ISBN: 081534130X.

Syllabus: K.U. Bioresources for 6th Semester **Course Code: BRS622J1**

Course Title: Industrial Entomology

Semester VI (Type I) Credits 4 (theory 3 +practical 1) Maximum Marks: 100 (75L+25P)

Course objectives:

- To introduce the domestic species of honey bees, silk worms.
- To study the modern methods of apiculture, rearing of silkworms and processing of Lac.
- To understand the commercial uses of silk and lac.
- To familiarize the learners to the economic aspects of apiculture, sericulture and lac culture.

Course outcome:

- Learner would adopt modern rearing techniques of honey bees and silkworms.
- Learners would realize the economic scope of apiculture, sericulture and lac culture.
- Learner would understand the processing techniques of stick Lac to powder Lac.
- Learner would understand products of sericulture, apiculture and Lac.

Unit: I **(15 Lecture)**

Apiculture: History and scope; Social organization, communication, and life history of honey bee, Products of apiculture (honey, Bee wax, bee venom); Bee keeping management and prospectus, bee keeping equipment; Modern methods in Apiculture; Diseases of honey bee and their management; Bee keeping as Industry in J&K.

Unit: II **(15 Lecture)**

History and scope, development and organization of silk industries, Food plants of silkworm their cultivation and management. Mulberry and non-mulberry silkworms; Bio-ecology of mulberry silkworm, Silkworm rearing technology, diseases, predators and parasitoids of silkworms and their management; Silkworm breeds, synthesis of silk and cocooning, harvesting and grainage. Status of sericulture industry in J&K?

Unit: III **(15 Lecture)**

Lac insect, biology, life cycle. Preparation of Feeding Ground for Lac Insects (Host, plants their management). Lac products, properties and their uses (lac dye, lac wax, shellac, bleached shellac, dewaxed bleached shellac, aleuritic acid); Enemies of Lac Insects and their Control; Parasites, Predators and microbial diseases. Edible and medicinal insect based industry.

Practical Work: 1 Credits

- Collection, preservation and identification of economically important insects.
- Study of life history of silk worm by rearing.
- Dissection of silk glands of the silk worm larva.
- Mounting: sting apparatus of Honey bees.
- Study of different castes of honey bee.
- Honey extraction and processing methods of hive products extraction.
- Quality analysis of honey.

Suggested Readings:

1. An introduction to Sericulture by G. Ganga & J. SulochanaChetty Oxford & IBH Publ. Co. pvt. Ltd.
2. Apiculture by P.J. Prost, Oxford & IBH, New Delhi
3. Economic and applied entomology by A. Kumar & P.M. Nigam Emkay Publications
4. Elements of Economic Entomology 8th Edition by B.V. David
5. Entomology: Novel Approaches by Jain,P.C. &M.C.Bhargava New India Publishing Agency, 101, Vikas Surya Plaza, Cu Block, Lsc Market, Pitam Pura, New Delhi 88, India
6. General and Appliedentomology by K. K. Nayar
7. Hand book of Economic Entomology by Shukla Daya Publishing House, New Delhi
8. Principles of sericulture by H. Aruga Oxford & IBH, New Delhi
   The fascinating world of bees by V.V. Rodionov& I.A. Shabarshov Mir Publ., Moscow

Syllabus: K.U. Bioresources for 6th Semester **Course Code: BRS622J2**

Course Title: Livestock Product Technology

Semester VI (Type II) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

Learning objectives:

1. To educate about common food adulterants and their detection.
2. To educate about standards and composition of foods and role of consumer.

Learning outcome: The learners will understand about basics of engineering as used in food processing and waste management and bio-utilization.

Unit I: Basic and General Aspects of Livestock Products (15 Lectures)

Milk and milk products- preservation of milk and production of fermented milk products (yoghurt, cheese and cultured butter milk). Meat and meat products- preservation and curing of meat. Egg and egg products- nutritive value, composition and preservation of egg. Sea foods- preservation and use of brine.

Composition and Physio-chemical properties of milk. Milk proteins, lipids, carbohydrates, minerals, vitamins and other minor constituents of milk. Nutritive value of milk. Processing and related techniques pasteurization and homogenization. Nutritive aspects and functional properties of different kinds of meat, fish, poultry and eggs. Food processing and food born infections.

Unit II: Packaging of animal products (15 Lectures)

Principles of packaging. Types of packaging material, methods and system of packaging. Standardization and quality control of packaging material. Active and smart packaging, antimicrobial packaging, edible films and coatings, nanocomposite materials for food packaging. Use of biosensors in livestock products packaging.

Unit III: Quality control and Marketing (15 Lectures)

Grades and grading of livestock products. Stress factors effecting meat quality-PSE, DFD, hot boning, cold shortening, thaw rigor, freezer burn and electrical stimulation. Regulatory and inspection methods – Municipal and state laws of Indian Standard and International Standards of fresh meat and poultry. Detection of antibiotics, chemical residues, heavy metals and toxins in meat. Techniques for detection of adulterations of meat. Present status, constrains and future aspects of livestock production and marketing in Jammu and Kashmir.

Unit IV: Post Harvest Technology (15 Lectures)

Consumer protection; role of voluntary agencies such as, Agmark, I.S.I. Quality control laboratories of companies ,private testing laboratories, Quality control laboratories of consumer co-operatives,. Standardization of Foods; Definition, Standards of Quality, Milk and milk products, Meat and meat products, poultry and canned fish.
Waste management; solid and liquid wastes; industrial effluents and their management, dairy industry and other food processing industries. Bio-utilization of wastes and by products.

Practicals

Testing adulteration of Milk and products:

A) Adulteration of Milk

Physical Tests; Detergent Test; Filter Test; Flow Test

B] Chemical Tests: Clot on boiling test; Test for starch in Milk; Test for cane sugar in Milk; Test for skim milk power in milk

- Detect the presence of added carbonates and bicarbonates in milk
- Adulteration of Ghee:
- Test for vegetable fat:
- Nitric acid test; Soda ash test
- Analysis of butter: Test for Dalda in butter.
- Adulteration of Paneer: Presence of starch in paneer.
- Food adulteration awareness campaign – know your food quality
- Visit to a State food testing Laboratory / NGRA Food Quality Testing Laboratory.

Reference Books;

1. Food Science & Quality Control by SMT. B. Poornima - Centrum Press First edition 2014.
2. A first course in Food Analysis – A.Y. Sathe, New Age International (P) Ltd., 1999. Food Microbiology – Frazier, W.C., Ed-4, Mc. Graw Hill – 2013.
3. Microbiology by John Garbult Essentials of Food Microbiology - Arnold International Student edition 1997.
4. Betty - c Hobbs & Diane Roberts – Food poisoning and food hygiene sixth edition by Arnold International Students edition – 1993.
5. Practical Food Microbiology & Technology – Mountnety Gould, Ed-3, Krieger Publishing Company, 1992.
6. Modern Food Microbiology – Jay J.H. CBS Publishers, 1990.
7. The Microbiological safety of processed foods – Growther, Marthi, Oxford and IBH Publishers Pvt. Ltd., 1988.

Syllabus: K.U. Bioresources for 6th Semester **Course Code: BRS622J3**

Course Title: Molecular Biology

Semester VI (Type III) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

Course objectives:

- Course chiefly concerns understanding different nucleic acids and proteins including the interactions between the different types of DNA, RNA, and protein biosynthesis and learning how these interactions are regulated.

Course outcomes:

- Upon successful completion of this course, students will be able to:
- Describe DNA replication, including the principle steps and enzymes involved.
- Illustrate DNA and RNA structure, replication, transcription, protein synthesis.
- Discuss DNA repair mechanisms.
- Describe transcription, including the principle steps and enzymes involved.
- In detail, describe the process of translation, identifying the principles steps.

Unit-I **(15 Lecture)**

Structure and Functions of Nucleic Acids:

The beginning of Molecular Biology; DNA: A carrier of genetic information, Chemical structure of DNA and Base composition, Watson-Crick model; Structure of different types of nucleic acids, Conformation of nucleic acids: A-, B-, Z-, DNA. Structure and function of different types of RNA (m-RNA & t-RNA).

Unit-II **(16 Lecture)**

DNA Synthesis and repair:

Unit of replication, enzymology of DNA replication, replication origin and replication fork, fidelity of replication, Mechanism of DNA replication in prokaryotes and eukaryotes. DNA damage and repair mechanisms.

Unit III **(16Lecture)**

RNA synthesis and processing:

Transcription in prokaryotes:Structure and function of RNA polymerases. Promoters. Transcription in Eukaryotes:Promoters, Transcription factors and enzymes, formation of initiation complex, elongation and termination. Transcription activators and repressors. RNA processing; capping, splicing and polyadenylation.

Unit-IV **(15 Lecture)**

Protein synthesis and processing:

Ribosome, genetic code, aminoacylation of tRNA, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination.Posttranslational modification of proteins (Overview).

Practical Work:

1. Demonstration of Gel Electrophoresis
2. Isolate DNA from biological samples
3. Characterize isolated DNA using agarose gel electrophoresis
4. Demonstration of Polymerase Chain Reaction, Gel electrophoresis and analysis of bands
5. Isolate a specific protein from a biological sample
6. Construction of calibration curve for protein estimation
7. Demonstration of SDS-PAGE electrophoresis

Books Recommended:

1. Freifelder D (2012). Molecular Biology, 5th edition. Narosa Publishing House, India
2. Berg JM, Tymoczko JL, Gatto GJ and Stryer L (2015) Biochemistry, 8th Edition, WH Freeman & Co., New York.
3. Allison A. Lizabeth (2012) Fundamental Molecular Biology, 2nd Edition. J Willey and Sons, Hoboken, New Jersey.
4. Freifelder D and Malacinski GM (2005) Essentials of Molecular Biology, 4th Edition, John and Bartlett Publishing, UK
5. Krebs JE., Kilpatrick ST and Goldstein ES. (2013). Lewin' GENES XI, Jones & Bartlett Learning. Burlington, MA.

Syllabus: K.U. Bioresources for 7th Semester **Course Code: BRS722J1**

Course Title: Bioresource Technology

Semester VII (Type I) Credits 4 (theory 3 +practical 1) Maximum Marks: 100 (75L+25P)

Course objectives: This course provides the students with an understanding of principles, techniques, concepts and methods associated with development and analysis of transgenics. This course is framed for providing a broader context about the advances in the field of recombinant DNA technology.

- Different molecular methods for genetic engineering and their application in plant transgenic for improved traits.
- Application of biotechnology in environmental clean-up, sustainability, nutrition and health
- The goal of this course is to provide the necessary theoretical knowledge on animals cells for in vitro studies for valuable products
- To understand the basic concept of stem cell therapy and tissue engineering focusing on biomaterials and its applications

Course outcomes: On completion of this course, the students will be able to:

- Learn Basic principles and applications of recombinant DNA technology.
- Learn molecular biology skills along with usage and applications of the instrumentation.
- Learn about the usage of transgenic for the production of biochemicals.
- Learn Ethical and legal issues of Recombinant DNA Technology.

Unit: I **(15 Lecture)**

Plant Biotechnology: Introduction, scope and applications; Cloning, Recombinant DNA technology– Restriction enzymes, gel electrophoresis, blotting techniques; Plant tissue culture and crop improvement; Methods of gene transfer ; Transgenic plants with improved traits, GMO's – ecological and ethical concerns.

Unit: II **(15 Lecture)**

Green concept in biotechnology: Bioremediation, bioleaching and biodegradation (heavy metals, hydrocarbons, xenobiotics); Microbes as biosensors; Microbes as source of medicinally important secondary metabolites; Bioflavours and Biocolourants obtained through bioresource biotechnology; Sources of Enzymes and their commercial use.

Unit: III **(15 Lecture)**

Animal cell and tissue culture: History, scope and applications; Transfection methods, Culture of cell lines; Transgenesis (cloning) and its application; Somatic cell fusion –

concept and utility. Cell culture products: Viral vaccines, interferons, recombinant proteins and hybrid antibodies; Hybridoma technology and production of monoclonal antibodies

Practical Work: 2 Credits

- Extraction of DNA from plant, microbe and animal tissue
- Demonstration of Agarose gel electrophoresis
- Preparation of plant tissue culture medium
- Demonstration of gene transfer methods
- Estimation of protein by Bradford method
- Effect of pollution on water quality: analyze BOD and COD
- Estimation of heavy metals in various samples by AAS.
- Demonstration of Biosensors.

Suggested Readings:

- *Applied Bioremediation and Phytoremediation.* A. Singh O. P. Ward (Eds), Springer, New York, NY, *2004*
- Desmond S. T. Nicholl (2008). An Introduction to Genetic Engineering, 3rd Edition, Cambridge University press.
- Ruane J, Sonnino A. 2006. The role of biotechnology in exploring and protecting agricultural genetic resources. Food and Agriculture Organization of the United Nations, Rome.
- Singh, B. D. (2007). Biotechnology: Expanding Horizons. Kalyani Publishers.
- Desmond S. T. Nicholl (2008). An Introduction to Genetic Engineering, 3rd Edition, Cambridge University press.
- Cooper Jeoffrey M-2013: Cell-A Molecular Approach, 6th Edition. Sinauer Assoc. Inc. USA
- Jocelyn E Krebs et al. 2010. Lewin's Gene X. Jones And Bartlett Publishers, Inc USA.
- Watson and others – 2004 : Molecular Biology of the gene (V); PearsesEducatias, Inc India
- P.C. Turner and others – 2002 : Molecular Biology (II); Viva Books, Pvt. Ltd., New Delhi.
- W. Ream and KG. Field – 1999 : Molecular Biology Techniques ; Academic Press, London.
- Bruce Alberts et al – 1983 : Molecular Biology of the cell ; Garland Publ. Inc., New Yorsk.

- Buchanan B, Gruissem G and Jones R. (2000) Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Rockville, USA.
- C. K. Matthews, K. E. Van Holde and K. G. Ahern. (2007).Biochemistry, 3rd Edition, Pearson Education, New Delhi
- Freshney, R. I. (2010). Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. Wiley-Blackwell, 2010. 6th Edition.
- Davis, J. M. (2008). Basic Cell Culture. Oxford University Press. New Delhi.
- Davis, J. M. (2011). Animal Cell Culture. John Willy and Sons Ltd. USA.
- Freshney R. I. (2005). Culture of Animal Cells. John Willy and Sons Ltd. USA.
- Butler, M. (2004). Animal Cell Culture and Technology. Taylor and Francis. New York, USA
- Bernhard O.Palsson,SangeetaN.Bhatia,"Tissue Engineering" Pearson Publishers 2009.
- Meyer, U.; Meyer, Th.; Handschel, J.; Wiesmann, H.P. Fundamentals of Tissue Engineering and Regenerative Medicine.2009.

Syllabus: K.U. Bioresources for 7th Semester **Course Code: BRS722J2**

Course Title: Bioresources in Health Management

Semester VII (Type II) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

Course objectives

- To familiarize the students about the relationship between food, nutrition, health and diseases which would make them aware about the role of macro and micro nutrients in diet
- To familiarize the students about the food servings (meal planning) and understand the nutrient metabolism as well as nutrient-microbe interaction.
- To familiarize the students about the benefits of consuming phytochemicals on regular bases and also develop the concept of food spoilage and safety.

Course outcomes

- On completion of the course the students are expected to have rational and critical knowledge associated with plant based diets and their uses by society.
- The students will be able to apply the scientific Knowledge of plant based diets for promotion of health by getting rid of the so called diseases of civilization.

Unit: I **(15 Lecture)**

Introduction: Plants in the diet of hunter gatherers; Plants in modern western diet; Plants as sources of proteins (amino acids, protein quality:PER, BV, NPU), carbohydrates(monosaccharides, disaccharides, polysaccharides), fats and lipids (types, importance and composition), vitamins (Fat soluble and water soluble) and minerals (biological role and occurance of inorganic elements).

Unit: II **(15 Lecture)**

Good things from plants in the diet: Dietary fibre and health, Antioxidants (phytochemicals, phytosterols); Gut microbiotome; Role of phytonutrients in influencing gut microbiotome.

Unit: III **(15 Lecture)**

Plants as source of healthy diet: Nutrition (energy value of food), Basal metabolic rate, Recommended dietary allowances (RDA), Natural health products (functional foods and neutraceuticals); Algae (Chlorella, Spirulina) and fungi (Mushrooms, Pleurotus) as source of human food; Plant diet in pregnancy, lactation, infancy, childhood and adolescence (Principles of meal planning of plant diet).

Unit: IV **(15 Lecture)**

Plant diet and diseases: Impact of food matrix and phytonutrients against chronic diseases; Plant diet and disease management— diabetes, heart disease, cancer, obesity; Plants in health improvement, fitness and sports (stamina, energy and food selection); Food safety and poisoning (spoilage, toxicity and allergy).

Practicals

- Demonstrate the grouping of plant foods according to ICMR classification.

- Demonstrate and compare the protein quantity in staple foods (Rice, Maize, Wheat).
- Demonstrate and compare the Total sugar in staple foods (Rice, Maize, Wheat).
- Observe the seeds of the staple foods.
- Observe the microscopic structure of different starches (rice, wheat and corn).
- Perform the qualitative tests of plant based foods for phenol and flavinoid
- Extraction of oil from nuts
- Demonstrate and compare the cellulose, lignin and hemicelluloses from important dietary plants

Suggested Reading:

1. Bamji MS, Krishnaswamy K, Brahmam GNV (2009). Textbook of Human Nutrition, 3rd Edition. Oxford and IBH Publishing Co. Pvt. Ltd.
2. Srilakshmi (2007). Food Science, 4th Edition. New Age International Ltd.
3. Srilakshmi (2005), Dietetics, Revised 5th edition. New Age International Ltd.
4. Wardlaw MG, Paul M Insel Mosby (1996). Perspectives in Nutrition, Third Edition.
5. Codex Guidelines on Nutrition Labelling (CAC/GL 2_1985) (Rev.1_1993). Rome, Food and Agriculture Organisation of the United Nations / World Health Organisation, 1993.
6. Food Safety and Standards Authority of India portal, Government of India
7. Gopalan, C (1990). NIN, ICMR. Nutritive Value of Indian Foods.
8. Seth V, Singh K (2005). Diet planning through the Life Cycle: Part 1. Normal Nutrition. A Practical Manual, Fourth edition, Elite Publishing House Pvt Ltd.

Syllabus: K.U. Bioresources for 7th Semester **Course Code: BRS722J3**

Course Title: Human Genetics

Semester VII (Type III) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

Course oobjectives:

To give the students an understanding of:

- Structure, Function and Inheritance of the human genome,
- Genomic Variation, Genotype-phenotype correlations,
- Pedigree analysis and Expressivity,
- Chromosomal Basis of Genetic Disorders and Genetic mapping.

Course outcomes:

- Course is specially designed to supplement and enhance the understanding of students about different dimensions of human genetics starting from genes to proteins and mutations in genes to the genes in the evolution of humans.
- This course is expected introduce the rapid advancements in our understanding the role of human genome in health and disease.

Unit: I (15 Lectures)

Basic Human Genetics: History of Human Genetics; Introduction to Hereditary and Inheritance; Pedigrees- gathering family history, pedigree symbols, construction of pedigrees; Monogenic traits - Autosomal inheritance-dominant and recessive; Pleiotropy; Polygenic inheritance; Multifactorial inheritance, Sex-linked inheritance- dominant and recessive; Sex-limited and sex-influenced traits; Y-linked ; Mitochondrial inheritance. Linkage and crossing over-Types.

Unit: II (15 Lectures)

Human Genome: The genome project- history, organization and goals of human genome project; mapping strategies, current status of various maps; human genome diversity; Organization of human genome, Mitochondrial genome, gross base composition of nuclear genome,gene density.Genetic mapping, Sequencing strategies (PCR based Sanger sequencing to Exome sequencing).Introduction to Epigenetics. Common mechanisms of Epigenetics, Epigenetics and diseases.

Unit: III (15 Lectures)

Clinical Genetics: Scope of clinical genetics; Monogenic diseases- Cystic fibrosis, Tay-Sachs syndrome, Marfan syndrome; Polygenic diseases- Hyperlipidemia, Diabetes mellitus,

Atherosclerosis; Inborn errors of metabolism and their genetic bases- Phenylketonuria, Maple syrup urine syndrome, Mucopolysaccharidosis, Galactosemia.Infertility - genetic basis of male infertility, genetic basis of female infertility; recurrent pregnancy loss.

Unit: IV (15 Lectures)

Genetic Counseling: Patterns of inheritance: classical and non classical, Overview of genetic counseling, components of genetic counseling, information gathering and construction of pedigrees and their interpretation. Risk assessment and counseling in common Mendelian and multifactorial syndromes, Management of genetic disorders.

Practicals:

- Genetics of Blood Groups a) ABO –typing b) Rh (D) typing
- Isolation of DNA from peripheral Blood
- Isolation of DNA from Tissue
- Isolation of RNA from Lymphocytes

References

1. Human Molecular Genetics by Tom Strachan, Andrew P. Read Garland Science/Taylor & Francis Group, 2011
2. Essentials Of Human Genetics Fifth Edition (University Press), By Manu L. Kothari, Lopa A. Mehta · 2009
3. Human Genetics: Concepts and Applications by Ricki Lewis, McGraw Hill Publishers 2020.
4. Human Genetics, 6th Edition, SD Gangane, Elsevier Publishers 2021
5. Principles of Genetics by EJ Gardner, MA, Simmons and DP Snustad, 8th Edition, Willey Press 2006.

Syllabus: K.U. Bioresources for 8th Semester **Course Code: BRS822J1**

Course Title: Biotechniques and Biostatistics

Semester VIII (Type I) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

Learning Objectives

- To study about types of data and analysis of measures of central tendency and graphical representation of data.
- To study measures of dispersion, correlation, regression and basic idea about hypothesis testing.
- To study principle and application of microscopy, spectroscopy and chromatography.

Learning Outcomes

- To learn the basic use of the statistical tools for problem solving in the field of biological science.
- To learn about methods of data collection, their limitation and basic measures central tendency and dispersion, correlation and regression and their application in biological studies.
- To learn about the application of basic biotechniques and tools in biological analysis and experimentation.

Unit: I **(16 Lectures)**

Types of data and Measures of central tendency: Types of Data and their advantages and limitations (Primary data and secondary data); Measures of central tendency (Mean, mode, median);Graphical representation of data (Bar diagram, line graph, Histogram, and Pie chart)

Unit: II **(16 Lectures)**

Measure of dispersion and Tests of Significance: Measures of dispersion (Mean deviation, variance, standard deviation)Simple linear correlation; Simple linear regression; Hypothesis testing (t-Test, and Chi Square test),F- test (One Way ANOVA).

Unit: III **(16 Lectures)**

Microscopyand spectroscopy: Principle, working & application of Compound Microscope, Fluorescence microscope, Scanning electron and Transmission electron microscopy; Principle and working of a spectrophotometer; Radioisotopes— applications in biology.

Unit: IV **(16 Lectures)**

Chromatography and Centrifugation: Principle and applications of Paper, Thin layer, Ion exchange, adsorption and molecular exclusion chromatography, High-performance liquid chromatography (HPLC); Centrifugation (Principle and its types).

Practical Work

- Collection of data from field and construction of frequency tables.
- Diagrammatic and graphical representation of data.
- Comparison of populations parameters based on mean, mode and median.
- Calculation of standard deviation
- Introduction to use of excel for data storage and analysis.
- Isolation of pigments using Paper and TL Chromatography
- Demonstration of microscopy (structure and use of compound microscope)
- Principle and working of a spectrophotometer (demonstration)

Suggested Readings

- Fundamentals of Biostatistics by Khan and Khanum, sixth edition, ISBN: 9788190944103.
- Fundamentals of Statistics. S.C. Gupta, 2018, ISBN: 9350517698.
- Biotechniques (Theory & Practice). Rastogi Publications by Prof. S.V.S. Rana. ISBN: 817133993X.
- Principles and Techniques of Biochemistry and Molecular Biology,Keith Wilson,John Walker ISBN: 9780521731676.
- Modern Biotechniques and Biotechnology by Gupta Neelima.

Syllabus: K.U. Bioresources for 8th Semester **Course Code: BRS822J2**

Course Title: Drug Discovery and Development

Semester VIII (Type II) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

Learning objectives

- Identify the various classifications of drug products.
- Understand the basic concepts of new drug development with emphasis on design and conduct of clinical trials and interpretation of their results.

Learning Outcome

- Use antimicrobials judiciously for therapy and prophylaxis.
- Evaluate scientific, ethical and market-related considerations of importance in the drug development.

Unit: I **(16 lectures)**

Drugs and mode of action:-Introduction to various classes of drugs, Drug discovery, Relation of Drug structure and its chemical and biological properties, Drug targets: Classification, structure, drug receptor interaction (G-protein, Ion channels and Ion channel linked receptors, nuclear receptors).

Unit: II **(16 lectures)**

Drug Simulation:- Computer aided drug designing, selection of targets, Docking and Molecular Docking Simulations. Various tools used for drug targeting. Antimicrobial drugs: Antibacterials: Discovery and development of Penicillin's and Tetracyclins.

Unit: III **(16 lectures)**

Drug development and toxicity: Stages of drug development;admet screening angLipink's rule, Drug laws, FDA. Different methods in toxicity testing: Dose determination, response characterization. Mechanism of toxicity: Evaluation across different models: Target organs, cell death, necrosis, apoptosis, oxidative stress, chromosome and DNA damage. Acute and chronic toxicity.

Unit: IV **(16 lectures)**

Approaches for Targeted Drug Delivery:- Principles of drug targeting and molecular basis of targeted drug delivery: Receptor mediated endocytosis; Different types of targeting-active and passive targeting. Disease based targeting approaches, Organ based targeting, Cell/Organelles based targeting, Carrier based approach for targeted drug delivery.

Practicals

1. Handling of laboratory animals.

- Various routes of drug administration.
- Techniques of blood sampling, anesthesia and euthanasia of experimental animals
- Oral glucose tolerance test.

2. Estimation of proteins by Braford/Lowry‟s in biological samples.
3. Protocol design for clinical trial.
4. In-silico docking studies.
5. In-silico pharmacophore based screening.

Suggested Readings

1. Pharmacology for Technicians: 6th edition, Ballington, Laughlin, and McKennon-Paradigm, 2017 – EVC Book Store
2. Goodman & Gilman's: The Pharmacological Basis of Therapeutics, 13e
3. An Introduction to Mechanisms in Pharmacology and Therapeutics, Howard Rogers and Roy Spector publisher Elsevier.
4. Drug Discovery and Development; Technology in Transition. HP Rang. Elsevier Ltd 1st edition 2006.
5. Pharmacology in Drug Discovery. T. P. Kenakin. Elsevier, 1st Edition 2012.
6. An introduction to medicinal chemistry. G. L. Patrick. 5th Edition Oxford UK, Oxford University Press, 2013.
7. Textbook of Drug Design. Krogsgaard-Larsen, Liljefors and Madsen (Editors), Taylor and Francis, London UK, 2002.
8. Drug Discovery Handbook S.C. Gad (Editor) Wiley-Interscience Hoboken USA, 2005.

Syllabus: K.U. Bioresources for 8th Semester **Course Code: BRS822J3**

Course Title: Medicinal Plants and Phytotherapeutics

Semester VIII (Type III) Credits 6 (theory 4 +practical 2) Maximum Marks: 150 (100L+50P)

Learning objectives

After completing this course, the student will be able to:

- To study the history and scope of plant derived drugs
- To study the characteristic and importance of major phytochemicals
- To know the extraction, purification and characterization of phytochemicals
- To know the process for development of plant drugs
- Discuss the advantages and disadvantages of Phytotherapy.
- Illustrate the natural products proven effective for the treatment of various diseases.

Course outcome:

- Knowledge on the history and scope of plant derived drugs
- Knowledge on the characteristic and importance of major phytochemical
- Knowledge on extraction , purification and characterization of phytochemical
- Understand the process for development of plant derived drugs
- Knowledge of phytotherapy, natural products of verified pharmacological effect with their mechanisms, active ingredients obtained from natural products.

Unit I: Medicinal plants

Medicinal Plants– past, present and future prospects in world and India. Biologically active substances of medicinal plants and their importance in determining phytotherapeutic effects.Ethno medicinal importance of some medicinal plants of J&K:- *Poddophyllum hexandrum, Violao orata, Aconitum heterophyllum, Picorhiza kurroa. Curcuma longa, Piper nigrum and Taraxicum officinale.*

Unit-II Phytomedicine

Definition, scope, importance and classification of plant based drugs. Preparation of Crude drugs in different systems of medicine. Value addition grading and processing of plant drugs. Bioprospecting tools for drug discovery. Plants based drugs and their therapeutic use - Dioscorea, Ginseng, Vinblastin, Vincristin Glycyrrhiza, Atropine, Digitoxin, Amygdalin, Cyanidin, Malvidin, Taxol, and Curcumin.

Unit – III Traditional System of Medicine

Introduction, Concept and Principles of Traditional System of Medicine (TSM)- Ayurveda, Unani, Siddha, Homeopathy and Amchi system. Bioprospecting, Biopiracy. Concept and importance of Traditional Knowledge of Digital Library (TKDL). Intellectual property Rights

(IPR)-concept. (copyright, trademarks, patents, geographical indications, plant varieties, industrial designs and Trade secrets).

Unit – IV Phytotherapy

Definition of phytotherapy, its role and place in modern medicine. Advantages and disadvantages of Phytotherapy. Phototherapeutic drugs and methods of their application. Phytomedicines used in parasitic, helminthiasis, protozoal and microbial infections, anti-diabetic, anti-cancer, skin diseases, nervous system, immune system.

Practicals:

1. Sample collection of the selected species as per the course content.
2. Extraction of phytochemicals by different methods.
3. Qualitative estimation of Phytochemical.
4. Preparation of Crude drugs in different systems of medicine
5. Identification and medicinal value of locally available medicinal plants.
6. Methods of propagation of important medicinal plants.
7. Demonstration of solvent/s extract/s preparation using Soxhlet apparatus.
8. To prepare crude drug from plant parts.
9. Isolation, purification of crude drug from plant parts.
10. Determination of phytochemicals in crude plant extracts.

Suggested Readings:

1. Medicinal Plants of the Himalays: advances and Insights by Amjad M Husaini (2010), Global Science Books, ISSN 1752-3389.
2. Medicinal Plants of Health and Wealth, by S.N.Das Agrotech Pblications, ISBN 9788183210232.
3. Fundamentals of Pharmacognosy and Phytotherapy; by Michael Heinrich, Joanne Barnes, Simon Gibbons and Elizabeth M Williamson (2012), Elsevier Ltd ISBN: 978-0-7020-3388-9.
4. Pharmacognosy; Trease and Evans. 16th Edition, 2009, Published by ELBS, London ISBN 978-0702029332
5. Medicinal Plants of Uttarakhand by C.P. Kala (2010).
6. Indian Medicinal Plants by P.C. Trivedi (2009).
7. Hand Book of Aromatic Plants by S.K. Bhattacharjee (2004).
8. Herbal therapy for human diseases: Irfan Ali Khan and Atiya Khanum (2007), Ukaaz publications ISBN: 81-88279-43-9.
9. Comprehensive pharmacy review; Leon S.Alan H. Mutnick et al; 4th edition ISBN:0-7817-2147-4.
10. Natural Medicines Comprehensive Database (www.naturaldatabase.com).